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**Review of
Equipment and
Materials that can
be Used by
Food Service
Facilities to Enhance
Cockroach Control
Programs**

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Acknowledgements

This report was funded by the U.S. Army Environmental Center, Aberdeen Proving Ground, 21010-5403 as a part of its effort to reduce pesticide use by the Army.

This work was also supported in part by appointments to the Post-graduate Internship Program at the USACHPPM, administered by the Oak Ridge Institute for Sciences and Education through an interagency agreement between the U.S. Department of Energy and USACHPPM.

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Review of Equipment and Materials that can be Used by Food Service Facilities to Enhance Cockroach Control Programs

1. BACKGROUND.

a. Historically, German cockroaches have thrived in food preparation facilities that provide abundant harborage sites and where poor cleaning practices provide abundant food. To control cockroaches and other pests in these facilities, pest controllers have relied almost exclusively on conventional chemical control techniques. As a result, pesticide resistance among populations of cockroaches infesting these facilities has become commonplace. It is well documented in the scientific literature that for cockroaches to survive and multiply they require three fundamental elements: water, harborage, and food. In general, the more abundant the harborage sites and available food in a facility, the larger the cockroach infestation that can be supported. Therefore, the removal or partial elimination of any of the three fundamental elements would significantly help to reduce the number of cockroaches found in these facilities and, as a result, serve to reduce the frequency and amount of pesticide required to manage cockroach infestations.

b. The phenomenal ability of German cockroaches to survive in human dwellings for hundreds of years despite the fact that there have been considerable efforts to control them makes it apparent that no single control effort will be effective in eliminating cockroach infestations. Therefore, it is generally recognized that a combination of control techniques [Integrated Pest Management (IPM)] will need to be implemented to reduce the number of cockroaches infesting our facilities.

2. PURPOSE. This report discusses three different non-chemical techniques (pressure washer, vacuuming, and caulking) which should be implemented as part of a comprehensive Integrated Pest Management program to control pests, especially the German cockroach, in a troop dining facility. It is important that dining facilities managers be knowledgeable concerning the benefits of these techniques and the types of equipment/materials that are commercially available to help reduce the amount of pesticides being used in dining facilities to mitigate pests. No pest control certification is required to accomplish any of these procedures.

3. TECHNIQUES.

a. Pressure Washers.

(1) Pressure washers are specialized units of equipment uniquely designed to clean up a wide variety of substances, structures, and equipment by applying water, solvents, and water-detergent formulations under pressure. Even though the equipment is not marketed as pest control equipment, it has been our experience that the combination of hot water (140°F) and high water pressure not only dislodges cockroaches from their harborages (e.g., behind sinks, dishwashers, and other inaccessible areas), but also produces some mortality. The cleaning process functions to reduce, or remove, the chemical scents (pheromones) produced by cockroaches which enable them to locate harborages and multiply. However, the primary benefit

of using a pressure washer in a dining facility is to remove residual food materials, which sustain cockroach infestations, and greasy materials from floors, equipment, and walls, which reduce the efficacy of conventional residual pesticides. It also provides clean surfaces, which facilitate the application of adhesive bait stations and enhance the effectiveness of cockroach gel baits. A combination of these factors should help to reduce the amount and frequency of pesticide applications in food preparation facilities. It is envisioned that in most areas of a dining facility a pressure washer would only have to be used once every 3 or 4 months to maintain adequate cleaning of structural and equipment surfaces.

(2) There are several commercial firms that offer a wide selection of models and accessories depending on the needs of the customer. Pressure washers are manufactured to apply hot and/or cold water or a combination of temperature ranges. Hot-water systems may be purchased using either electric, propane, diesel, or natural gas as the heating element. Cold-water systems (some are capable of handling hot water) are normally electric or powered by small gasoline engines. All systems offer a wide range of pressure options and cleaning accessories. Equipment specifications and recommendations can be readily obtained from a pressure washer dealer.

(3) Prior to using a pressure washer in a dining facility, it is necessary to ensure that the area is prepared for cleaning by removing any excess equipment and/or items that may be damaged by water, and that floor drains have been checked to be functional. The removal of items from the floor and walls greatly facilitates the cleaning process. In addition, precautions must be taken to reduce the possibility for electrical shock by disconnecting electrical appliances. Adequate cleaning equipment should be on hand (e.g., brooms, mops, and squeegees).

(4) A typical military dining facility was selected as a site to demonstrate the utility of using a pressure washer to remove common kitchen food residues and grime which support cockroach infestations. The facility had undergone a major renovation in the 1970's. Floors and walls throughout the dining facility were predominately finished with standard ceramic tiles. Based on historical cockroach surveillance data for this facility, infestations were shown to be highest in the dishwasher room (**Figure 1**), the serving line, and the pot/pan dishwash area (**Figure 2**).



Figure 1



Figure 2

Large populations of cockroaches were observed to be hiding in the dark voids created by the stainless steel back-splashes in the pot/pan and dishwasher areas, and entering holes into the cinder-block walls. Since sinks for washing pots and pans and tray returns in dishwash rooms are often installed next to wall surfaces, it is very difficult to clean these areas adequately. Deposits of food residue and moisture combine to form a grungy, organic-based film on the floor, walls, and equipment which support cockroach infestations (**Figures 3 and 4**).

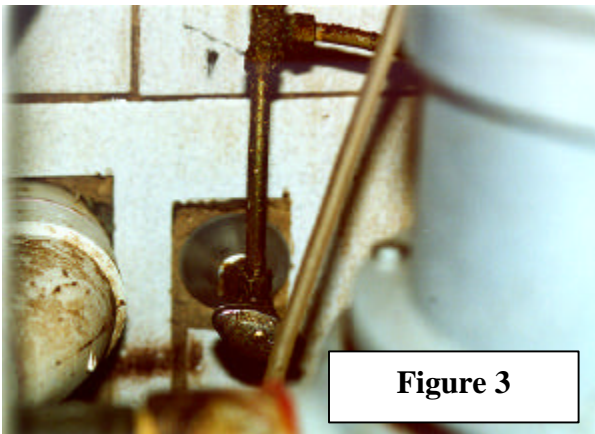


Figure 3



Figure 4

The darkened voids formed by the back-splashes create harborage for cockroaches (**Figures 5 and 6**). Since these areas are difficult to get to and often out of direct sight, the cleaning staff is reluctant to clean the soiled walls and floor. However, with the use of a pressure washer and a good detergent, these areas can be easily cleaned by a one- or two-person cleaning crew.

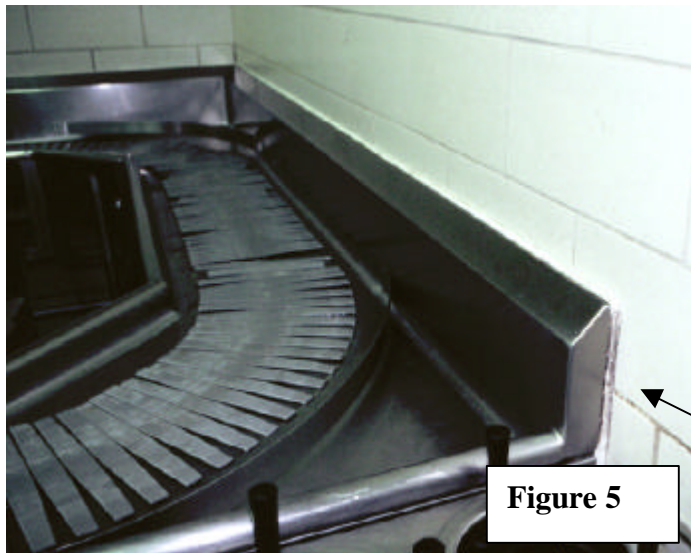


Figure 5

Tray Return Back-splash

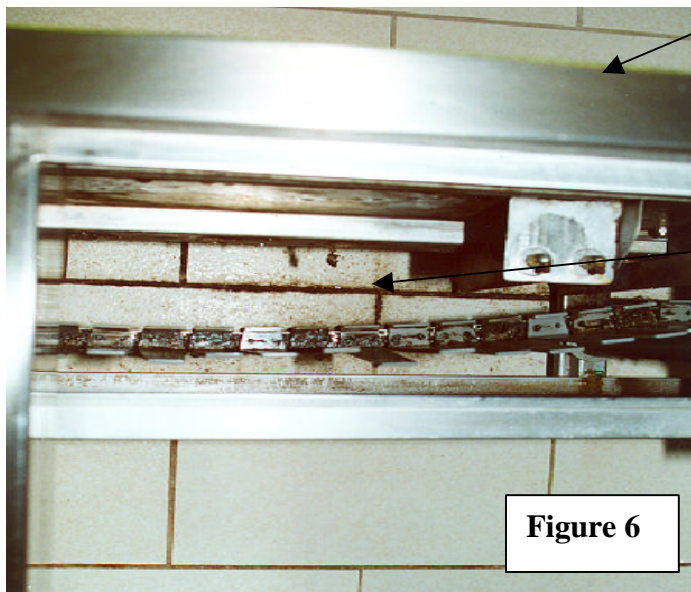


Figure 6

Soiled Area Under Tray Return

(5) Two different models of pressure washers (Space Shuttle Series, Models 1700 and E#145) were evaluated during this field trial. The units were rated for light industry (home, boat, hotel, property) or medium industry (farm, service industry, construction). The SS 1700 GFI Model (**Figure 7**) has an adjustable water pressure from 100-1650 pounds per square inch (PSI) and uses approximately 1.7 gallons of water per minute (GPM). The E#145 Model has an adjustable water pressure from 100-1450 PSI and uses approximately 2.4 GPM. Both pressure

washers were equipped with a special “Dirt Killer” spinning nozzle for enhanced cleaning power. An all-purpose detergent, mixed according to label instructions, was placed in a 2-gallon sprayer (Chap Premier, Model #1243) and applied to the areas to be cleaned. The detergent was allowed to set for approximately 5 minutes prior to being pressure washed with hot water. Both units were capable of operating with hot water. Model 1700 has a maximum water temperature rating of 160°F, while the E#145 Model had a maximum water temperature rating of 140°F. Both units were supplied with hot water through a 25-foot garden hose attached to a local faucet. The pressure washer regulating valves were set to deliver maximum pressure and volume. As marketed by the pressure washer manufactures, turbo spray nozzles provide additional cleaning power that cannot be obtained by standard, flat-tip spray nozzles. Depending on the difficulty of the area, an operator can clean several square feet of area within 1 hour. It is estimated that most dishwasher rooms (26x21 sq. ft) can be cleaned within 2 hours, including rinsing and removing rinse water from the floor, provided that two or more persons are involved in the cleanup.

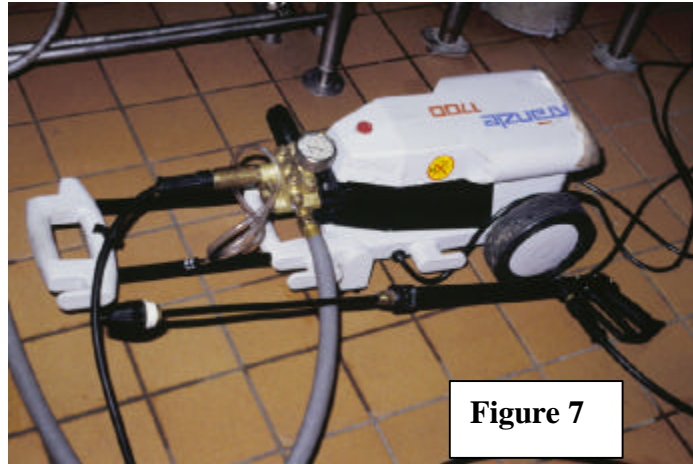
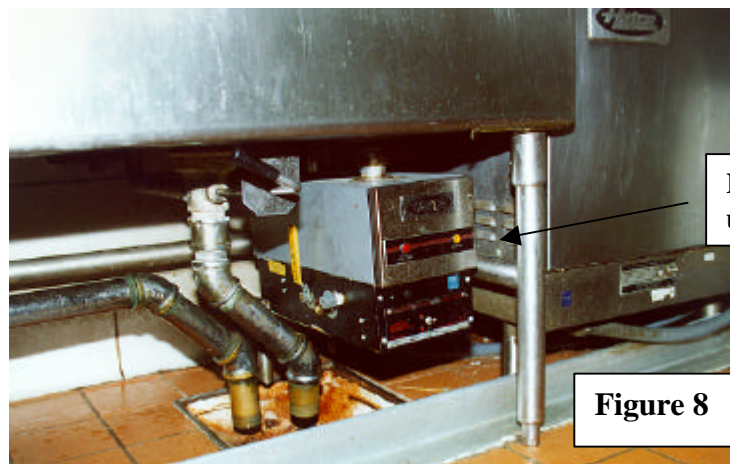


Figure 7

(6) Since water is being applied in areas that have electrical wires and equipment, it is mandatory that reasonable precautions be taken. Where possible, all appliances should be disconnected from their electrical power sources and allowed sufficient time to dry before being used and/or reconnected. Extra care should be exercised not to spray the electrical outlets and control switches associated with the different pieces of equipment in the dining facility (**Figure 8**). The mixture of detergent, oils, and water combine to make the floor unusually slick; therefore, the



**Electrical control
unit for appliances**

Figure 8

dining facility manager must ensure that the cleanup crew has been warned about this hazard and encouraged to use proper footwear for the job.

(7) **Recommendations:** The use of pressure washers in dining facilities is highly recommended to enhance the control of cockroach infestations. The equipment selected should have the capability to operate with both hot and cold water. It should also use less than 2 gallons of water per minute, since the excess volume of water is difficult to manage. It is not necessary to use pressure washer equipment rated above 2000 PSI in dining facilities to obtain optimum cleaning. Due to the weight, size, and potentially dangerous exhaust fumes, fuel-burning models of pressure washers are not recommended for indoor facilities. Special biodegradable detergents are available which facilitate the quick removal of oil and food deposits on soiled surfaces.

b. Vacuum Cleaners.

(1) It is common knowledge that vacuum sweepers are designed for cleaning; however, what is not generally known is that vacuum sweepers can be a very effective tool in managing pest populations such as cockroaches. With the public concern for good environmental stewardship, the pest control industry is looking to other alternatives to reduce or eliminate their reliance on strictly chemical control methods. In USACHPPM's field trials of developing and evaluating thermal technology to control German cockroaches in military dining facilities, dry-pickup vacuum sweepers (**Figure 9**) were used extensively in removing



Figure 9

cockroaches that congregated in cool spots to escape the heat being generated to kill them. Vacuum devices are being used more in the pest control industry because they enable the pest control technician (PCT) to target specific pests or harborages without applying pesticides. Some of the harborages accessible to vacuuming are electrical breaker boxes and outlets, compressor compartments of freezers and refrigerators, under and behind sinks, and wall-mounted items. Other insect taxa accessible to mechanical removal or control are isolated groups of wasps, flies, spiders, fleas, or dust mites. The removal of insects by mechanical techniques offers immediate pest elimination, so the PCT does not have to wait for chemical toxins to take effect. However, when removing pests from the various harborages or foci, water (or any other liquid) may present some problems since the filters of most vacuum sweepers are not designed to be used with wet liquids. In addition, the types of accessories provided with vacuum sweepers may not offer the versatility required to collect cockroaches and other pests from difficult or inaccessible areas.

Therefore, it is necessary to special order additional vacuum attachments or fabricate the

necessary suction devices. Nevertheless, the vacuuming of pests offers some real environmental benefits of nonchemical control and immediate pest removal.

(2) Commercially, there is a broad range of vacuum sweeper brands, models, and prices. However, only a few models are considered to be satisfactory for cockroach control. Therefore, it is incumbent upon the pest management coordinator or PCT to select the best piece of equipment for the type of pest control being performed. Some of the features that should be considered when purchasing a vacuum sweeper for pest control operations are power, versatility, durability, filtering characteristics and price.

- (a) Power. The number of amperes or horsepower of the electrical motor indicates the power rating of a vacuum sweeper with the higher number representing more vacuuming power. In order to vacuum most insects, the electrical motor should be rated at least at 8 to 12 amps or 1 to 2 horsepower (HP). However, air flow [cubic feet per minute (CFM)] and water lift capabilities are other indicators which give reference to the power of the unit. The latter two factors are normally stated in the equipment specification section of the operation manual provided by the manufacture.
 - (b) Versatility. Vacuum sweepers are designed to operate in specific environments and handle certain types of materials. For example, wet/dry vacuum systems are built to vacuum liquids as well as dry materials; however, a dry vacuum system should only be used to handle nonhazardous dry materials. Moreover, the size and structural design of the unit purchased should allow the PCT to move about using the vacuum device without being obstructed. The manufacturer of the model selected should offer a wide range of tools and accessories with the vacuum unit to allow for the collections of arthropods under a variety of conditions.
 - (c) Durability. Durability is an important characteristic of any vacuum system. It should be built to operate several hours without having to service the motor or replace worn or broken parts. Quality vacuum sweepers will normally be constructed of high-impact plastic (polyethylene) housing and metallic motor parts. The manufacturer's warranty is a good indicator of the durability and quality of any piece of equipment.
 - (d) Filtering Characteristics. Since air quality is an important aspect of any work environment, it is important that a PCT use vacuuming equipment which does not diminish the air quality by passing particulate materials through the filtering system. A quality vacuum sweeper should remove most, if not all, of the solid particles (i.e., house dust mites, insect parts, and other allergens) being removed by the vacuum sweeper. To remove these items, the vacuum sweeper should have a HEPA filter.
 - (e) Price. The price of a quality vacuum system that has many of the features desired by most pest controllers ranges from \$200 to \$500 or more.
- (3) **Recommendations:** Vacuum sweepers can be a valuable pest control device and

should be used as much as possible in food service facilities to help manage cockroach infestations. The model selected should be easily portable and powerful enough to remove the pests from their harborages. Due to the dust and cockroach allergens that can be passed into the air during operation, the vacuum sweeper used in a dining facility should have a high-efficiency particulate air (HEPA) filter as part of its filtration system. In areas that have water or other liquids, a wet/dry vacuum sweeper should be used.

c. Caulking.

(1) Cockroaches and other pests normally seek refuge in cracks and crevices and other small harborage or temporary hiding sites. Fortunately, many of the areas where cockroaches are found can be rendered inaccessible to them by creating a physical barrier which either prevents them from gaining access to or escape from a preferred habitat. In dining facilities there are numerous places which function as cockroach harborages (i.e., wall voids and accesses, hollow doors, equipment compartments, food serving equipment, wall pictures and plaques, electrical boxes and conduits, and loose floor, wall and ceiling tiles). The elimination of potential cockroach harborages and/or access routes is an essential part of any comprehensive cockroach management program. All too commonly, building contractors in Government food service facilities do not finish or seal potential insect harborages (electrical, water and steam lines, and permanent dining facility equipment) in the process of building or remodeling a dining facility. As a result, dining facilities are constructed with numerous cockroach harborage sites. It is always more difficult to eliminate cockroach harborages after a building is occupied and serving food than in the construction phase. Nevertheless, caulking or sealing cockroach harborages will definitely reduce cockroach populations in a dining facility and help to reduce the amount of pesticides being applied for cockroach control. All sealing must be done thoroughly. Improperly applied sealant, which leaves a hole as small as 1/8th by 3/16th of an inch will still allow cockroaches access to the area. It should be noted that not all caulks meet the guidelines (Food and Drug Agency, National Sanitation Foundation, Military Specification) for use in food handling areas. Therefore, it is incumbent on the applicator to check the Manufacturer's Material Safety Data Sheet for product application guidelines and safety issues.

(2) Comprehensive surveillance of a dining facility is an essential element of any cockroach pest management program. The PCT should be able to document and identify cockroach harborages or accesses to harborages that can be eliminated by caulking or other types of sealants. **Figures 10 and 11** show some typical access areas to cockroach harborages that could be eliminated by proper caulking.

(2) Several different types of caulks and/or sealants are commercially available which vary in quality, color, and serviceability. Some caulks are paintable and can be cleaned up with water after application, while others are not recommended to be painted and require solvents to be removed from the surfaces. As with a number of other construction products, caulks are designed to accomplish specific functions, for example to bond similar or different materials,

seal small or large gaps, or function under different temperature ranges. Caulks are mainly either a

silicone, acrylic latex, or combination silicone-latex material. Most home centers and hardware stores offer a variety of caulking supplies and caulks; however, it should be kept in mind that the more expensive specialty caulks which provide the best results may have to be purchased at contractor supply companies. Since the cost of labor is the most expensive factor in caulking a dining facility, it is highly recommended that a high-quality caulk be applied in order to obtain the maximum serviceability. In areas where there is a lot of water being used or remains moist (e.g., pot/pan wash room and dishwasher areas), a caulk that is both moisture and mildew resistant should be applied. Caulks without a mildew inhibitor when applied in moist areas will deteriorate rapidly and blacken.

(4) Equally important, the applicator must be knowledgeable of the conditions specified by the manufacturer for proper caulk application and how to prepare the surface(s) for proper caulk adhesion. Even superior caulking materials will fail to give satisfactory results if the necessary preparations have not been taken. Surfaces to be caulked must be clean, dry, free of loose materials, dirt, oils, sound, and must fall within the recommended temperature range for caulk/sealant application.



Figure 10

To eliminate some of the harborage sites for cockroaches, caulk needs to be applied to areas where items are attached to walls and where electrical, gas and water pipes pass through walls. Arrows

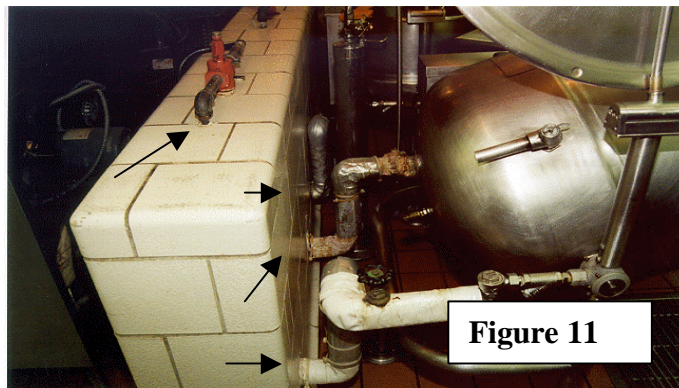


Figure 11

(a) **Figure 12** illustrates what happens to areas that have been caulked but have not been maintained. The cracks and crevices created by damaged grout and/or caulk become preferred harborages for infesting cockroaches. Frequently, this condition permits passageways to larger voids within the building structure.

(b) All nonporous surfaces that will come in contact with the sealants should be cleaned with approved solvents.

If the joint or gap is too wide ($>1/2$ inch) or too deep, then a filler or backing such as fiberglass or a polyethylene backer rod should be used to partially fill the area before applying caulk. Caulks should not be applied too thinly since the caulking material could be easily damaged; likewise, caulks should not be used to fill deep openings. Thick applications of caulk become rigid and will not flex with surfaces that have some movement. Some types of caulks recommend that the surfaces of the materials be treated first with a primer to increase adhesion and durability. In some instance, the chemicals used to formulate the caulks/sealeants can damage the substrates receiving the caulking material. For example, acid-cured caulks are not recommended for bonding to concrete or plastic materials, such as vinyl. In some cases, the release of acetic acid during the curing of caulks can corrode some metals such as copper, steel, brass, and galvanized iron. In areas where moisture/water and mildew are a problem, caulks that are silicone or have a high silicone content should be used. Latex or acrylic-latex caulks can be used for interior, dry areas which do not come into incidental contact with food or drinking water; however, they should not be used as the caulk of choice for exterior areas.



(5) **Recommendations:** Caulking cockroach harborage sites is an essential part of a pest management program in any cockroach-infested facility. Management and/or support pest control personnel should identify any areas that have not been properly sealed and initiate work orders to have all accessible cockroach harborage sites caulked. Only those caulks approved for food preparation areas should be applied.

4. SUMMARY. The overall goal for IPM in military dining facilities is to control cockroaches within acceptable, established parameters through the use of chemical and/or nonchemical techniques. To this goal, pressure washers, vacuum sweepers, and/or caulking can be effectively used to augment conventional cockroach control efforts and help to reduce the amount and frequency of chemicals being applied. These techniques serve to reduce or eliminate one or more of those factors (food, water, and harborage) which are considered critical for a cockroach population to maintain itself and flourish in a facility. It is incumbent on the management of food handling facilities to request and/or facilitate IPM practices within their facilities to make a healthy and cockroach-free environment for the troops.